Biotechnology

Know the meaning/significance of: recombinant DNA, gene cloning, mosaic, chimera, transgenic organism, vector, transformation, Taq polymerase, probe, vector, reporter gene, “sticky end”, constitutive mutant

Know the meaning/significance of: restriction endonuclease/enzyme, restriction fragment, restriction site.

Review the link explaining restriction enzymes and their function at http://www.bio.miami.edu/dana/dox/restrictionenzymes.html

What is the purpose of the Polymerase Chain Reaction? Electrophoresis? Southern, Northern and Western Blots?

What are the three general possible results of an attempted gene transfer into a new cell?

What is the purpose of genomics? What is the difference between structural and functional genomics? What is bioinformatics?

Know the meaning/significance of: dispersed gene families, pseudogene, tandem gene family arrays, non-coding functional sequences (examples), highly repetitive centromeric DNA, VNTR, DNA fingerprints, “spacer” DNA

Know the meaning/significance of: genomics, cDNA library, bioinformatics, expression vector, expression vector

What is a DNA library? What are the different types of DNA library, and how are they different from each other?

Know how the Dideoxy method (Sanger method) of DNA sequencing works, and how to read the resulting gel.

(Vie the video tutorial linked to the notes for a good review)

Read the brief section on Knockout Technology in the notes, and know the purpose of Knockout Technology. Don’t angst about the specifics of the matings, but understand the purpose of Knockout Technology.

Control of Gene Expression in Microbes

Know the meaning/significance and general mechanism of: operon, promoter, operator, repressor, inducer, corepressor, stem loop (and their function in gene regulation), catabolism vs. anabolism, repressible vs. inducible systems, positive vs. negative control, attenuator control, Pribnow Box, Shine-Dalgarno sequence.

Know the basic workings of the lac, trp, and arabinose operons, and be sure you understand which ones are under negative, positive, attenuator control, which are inducible or repressible, etc.

Know the meaning/significance/application of: allosteric protein, inducer, positive feedback, isomerization, constitutive transcription (or translation),

Understand the difference between the control of gene expression at the levels of transcription, translation, and protein activity. Know what each implies in terms of energy expense and quickness of gene expression under changing environmental conditions.

Understand some of the ways a cell can exert control a each of the above mechanisms of gene expression control. (RNA hybridization, ribosome binding efficiency, etc.)

Control of Gene Expression in Eukaryotes

Know the basic similarities and differences between gene expression control in bacteria and eukaryotes. What cellular “participants” are present in both, and which are unique to each? What mechanisms are homologous (if any), and which are analogous?

Know the meaning/significance of: enhancer, silencer, activator, repressor, nucleosome, histones,

Understand the mechanisms of modifying the primary mRNA transcript, and the significance/function of each modification.

Know the meaning/significance of: TATA Box/Hogness Box, cis-acting element, trans-acting element, domain (in protein) motif (in nucleic acid), transcription factor, regulatory element

Recall the structure of eukaryotic chromatin, and what the various components of the structure contribute to control of gene expression

Know the meaning/significance of: histones and their tails, nucleosomes, etc., chromatin remodeling, histone remodeling, ubiquitination, phosphorylation, dephosphorylation, phosphatase, phosphorylase, ubiquitin, proteasome, (follow the links!)

Understand what is meant by: Histone Code, hyperacetylation, hypoacetylation, enhanceosome

Understand the role of the following in gene expression control: mRNA lifespan, mRNA modification, transport control.

Know the identity and roles of the enzymes and functional RNA molecules involved in gene expression control: dsRNA, miRNA, siRNA, etc. Understand the basic mechanism of RNA interference

Understand the role of DNA methylation in gene expression control, and how it relates to genomic imprinting.

Understand the inheritance of genomic imprinting, and know the meaning/significance of: paramutation, epigenetic inheritance, maternal vs. paternal imprinting, monoallelic inheritance, genomic imprinting and cloning

Understand the basic mechanism of RNA interference, and how it is triggered.

Understand the mechanisms and components of of post-translational control including: protein lifespan, N-end Rule, REST Hypothesis, RNAi, epigenetic silencing, dosage compensation, hormones

Understand the mechanism of position effect, and be able to recognize examples.

Know the basic configuration of the known isomers of DNA, and which are likely involved in gene expression control.

Remember: This isn’t a substitute for your notes or text. Anything covered in class (including text readings on topics we covered in class) is fair game!
**Genetics of Development**

**Know** the meaning/significance of: totipotent, pluripotent, multipotent, ontogeny, morphogenesis, cell differentiation, paracrine signaling, cell fate, gene complex, developmental field, fate refinement, blastomere

**Know** the major developmental difference between protostomes and deuterostomes (blastopore fate; determinate vs. indeterminate cleavage, developmental flexibility)

**Understand** how gene regulation at various levels can be used to direct embryo development.

**Know** the hierarchy of genes and gene products that affect each other as an embryo develops, from maternal effect to

**Know** the meaning/significance of: metameres/metamerism, loss-of-function vs. gain-of-function mutations, cDNA, maternally-required vs. zygotically required gene products, patterning genes, paedomorphy

**Know** the meaning/function of: Hox genes, homeo domain, homeo box, helix-turn-helix, maternal effect genes, morphogens, gap genes, pair-rule genes, segment polarity genes, hedgehog signaling pathway (and genes),

**Understand** how gene expression control is exerted during ontogeny at the level of post-transcriptional regulation (alternative splicing, regulation of mRNA translation, miRNA control)

**Know** what is meant by the term “genetic toolkit”.

**Mutations at the Molecular Level**

**Know** the meaning/significance of: mutation (process and effect), evolution, organic evolution, microevolution, macroevolution, physiological adaptation vs. evolutionary adaptation, mutagen, carcinogen

**Understand** the meaning/significance of: germline vs. somatic mutations, determinate vs. indeterminate growth

**Understand** what is meant by the various types of mutations: point mutation, transition, transversion, silent vs. synonymous, missense, conservative vs. nonconservative, nonsense, frameshift, suppressors, neutral, forward vs. reverse, exact vs. equivalent reversion, pseudo wild type,

**Understand** the significance of mutations in coding vs. non-coding DNA regions, and know the various causes of mutations.

**Understand** the nature of various types of mutations such as: depurination, deamination, oxidative damage, tautomer-induced mispairing/tautomeric shift, trinucleotide repeats (and genetic anticipation, premutation)

**Be familiar with** the nature and operation of various types of mutagens, including: chemical (based modifying agents, base analogs, intercalating agents, mycotoxins, ionizing radiation.

**Know** the meaning/significance of: free radical, pyrimidine dimer, xeroderma pigmentosum, dimer repair mechanisms (e.g., photolyase), damage prevention vs. excision repair, damage reversal

**Know** how endonucleases and exonucleases can cooperate with polymerase I and ligase to effect excision repair

**Know** the meaning/significance of: essential gene, lethal mutation, morphological mutation, conditional mutant, restrictive vs. permissive conditions